

# Advanced Research

## Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Advanced Research					
Coal Utilization Science .....	8,781	11,852	8,000	-3,852	-32.5%
Materials .....	8,712	11,111	8,000	-3,111	-28.0%
Technology Crosscut .....	11,078	11,326	10,500	-826	-7.3%
University Coal Research .....	2,904	2,945	3,000	+55	+1.9%
HBCUs, Education & Training .....	969	981	1,000	+19	+1.9%
Total, Advanced Research.....	32,444	38,215	30,500	-7,715	-20.2%

## Description

The mission of the Advanced Research subprogram is to serve as a bridge between basic and applied research to foster the development and deployment of innovative systems for improving efficiency and environmental performance, while reducing costs, of Advanced Coal and Power Systems.

## Benefits

Advanced Research provides the means by which advanced concepts are transformed into future working technologies. It is crosscutting in nature and supports all Fossil Energy Coal and Power Systems in its development of highly efficient power plants with zero emissions and also FutureGen. Improvement of our energy infrastructure, which includes power plants, power transmission systems, environmental protection and remediation efforts, is dependent on research. This research must produce technologies that meet the performance specifications for hostile operating conditions, economic constraints of advanced industrial applications, and public demand for a cleaner environment, reliability, and low consumer cost. These constraints require that advanced Research develop fundamental understandings of relationships among energy processes, their performance requirements, and the environment through a greater understanding of the physical, chemical, biological and thermodynamic barriers to achieving these goals. Especially important research is being conducted in the areas of materials research, sensors and controls, and computational energy science that is expected to eliminate the need for constructing expensive pilot plants.

## Background

The Advanced Research Program works to create public benefits through two types of activities. The first is a set of crosscutting studies and assessment activities in environmental, technical and economic analyses, coal technology export and international program support. The public benefits from these activities because the improvement of programs and regulatory activities will help to maximize their benefits and lower their costs. The second is a set of crosscutting fundamental and applied research

programs which include coal utilization science, materials, bioprocessing of coal, and university-based research. The public benefits from these activities because the long-term, high-risk activities target areas where industry is reluctant to invest. These research activities can produce public benefits such as increased energy efficiency, reduced pollution, or more reliable power supplies. For example, the university-based research programs include the University Coal Research program and the Historically Black Colleges and Universities and Other Minority Institutions (HBCU/OMI) program, address the full spectrum of fossil utilization research and development, technology transfer, outreach, and private sector partnerships.

In the crosscutting studies and assessments subprograms, the thrusts of international program support, environmental activities, coal technology export, and technical and economic analysis are to complement and enhance all Fossil Energy endeavors by providing both financial and technological leverage. International involvement is limited to those selected areas where it has been determined that the U.S. will benefit at least to the extent it contributes. Fossil Energy, through these activities, always attempts to encourage the leveraging of research and development funds while promoting U.S. industrial interests and to use them as opportunities to achieve responsible international consensus and opinion on technical business assessment and policy issues.

The crosscutting fundamental and applied research programs focus upon developing the technology base in the enabling science and technology areas that are critical to the successful development of both superclean, very high efficiency coal-based power systems and coal-based fuel systems with greatly reduced or no net emissions of CO<sub>2</sub>. These systems are encompassed in the Vision 21 energyplex and FutureGen initiative. Advanced Research seeks a greater understanding of the physical, chemical, biological and thermodynamic barriers to achieving economic, technologic, and environmental goals and identifies ways to overcome those barriers. The program is unique in that it is directed to specific underlying fundamental scientific and engineering problems closely connected to short-term, mid-term and long-range Fossil Energy objectives.

In order to achieve these goals, an Advanced Research focus area on Computational Energy Sciences was established at the National Energy Technology Laboratory (NETL). This focus area will conduct simulations and modeling activities to produce a "technology base" from which the energy plants of the future will be designed, built and operated.

The Coal Utilization Science subprogram focuses on research pertinent to all coal utilization systems, with specific attention paid to increasing our knowledge of the principal mechanisms that control coal conversion processes. It will address issues affecting the utilization of coal, and its primary thrust is in support of the development of the Vision 21 concept. It will involve novel concepts for CO<sub>2</sub> capture and sequestration, such as mineral carbonation, and virtual simulations and modeling of components and subsystems. It will also include research on instrumentation and diagnostics to support the development of advanced controls and sensors. High performance Advanced Materials and equipment are essential to advanced coal technologies. Thus, the thrust of the Advanced Materials subprogram is to develop materials for advanced gas separation and particulate removal, as well as to develop solutions to materials performance barriers unique to very high temperature, highly corrosive coal combustion and gasification environments. Exploratory research and innovation to maximize the use of coal in environmentally preferable ways is typified by the bioprocessing of coal subprogram. The focus of the

Biotechnology subprogram is to conduct biological research to produce clean fuels and to reduce greenhouse gas emissions (NO<sub>x</sub>, SO<sub>x</sub>, and CO<sub>2</sub>) from existing and new powerplants. The University Coal Research and HBCU/OMI subprograms are both education and training programs that support competitively awarded research grants at U.S. colleges and universities to address Fossil Energy's highest priority research needs.

### Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
<b>Coal Utilization Science</b> .....	<b>8,781</b>	<b>11,852</b>	<b>8,000</b>
• <b>Coal Utilization Science (Core)</b> .....	<b>8,692</b>	<b>6,802</b>	<b>7,920</b>

In FY 2005, conduct research that supports the development of highly efficient and clean power plants, focusing on the reduction or elimination of adverse environmental impacts of coal use. Sensors and controls: Complete prototype development and testing of sensors critical to enhancing and controlling plant efficiencies and emissions. Continue to develop new class of sensors based on projects selected through FY 2002 and FY 2003 solicitations that are suitable for monitoring in harsh conditions that will enable the operation of ultra-clean fossil energy systems. Enabling Technologies: Complete development of computational workbench for Vision 21. Initiate mechanistic 3D modeling of Vision 21 plant. Continue to investigate basic combustion and gasification chemistry to discern rates and mechanisms that control emissions behavior of coal under advanced and conventional combustion/gasification conditions to efficiently minimize NO<sub>x</sub>, SO<sub>x</sub>, air toxics, and other pollutants in support of the clear skies initiative. Complete integration of mechanical, chemical, and chemico-mechanical pretreatment into CO<sub>2</sub> mineral carbonation process. No funds for Arctic Energy Office. *Participants include: NETL, SNL, CMU, U. of Pittsburgh, ARC, Ohio State U., REI, U. of Fl, MSU.*

In FY 2004, conducted research to enable reduction or elimination of environmental impacts of coal use; focus on greenhouse gases that may affect global climate change. Sensors and Controls: Completed pilot-scale tests of select gasification and combustion sensors; complete feasibility tests of other sensor development projects selected under FY 2002 solicitations. Select fewer projects for award under FY 2003 solicitations for fundamental sensor devices including applications of nanotechnology. Continued stochastic modeling and systems analysis for zero emissions power plants concepts and FutureGen. Completed Round 2 course grid simulations and computational workbench projects and continued projects selected under round III of broad-based agency Vision 21 solicitation to develop critical enabling technologies for advanced zero emissions power and fuel systems. Investigated basic combustion and gasification chemistry to discern rates and mechanisms that control emissions behavior of coal under advanced and conventional combustion gasification conditions to efficiently minimize NO<sub>x</sub>, SO<sub>x</sub>, air toxics, and other pollutants in support of the Clear Skies Initiative. Developed predictive models as a tool for designers of Vision 21 plants. Demonstrate the feasibility of the in-situ CO<sub>2</sub> mineral sequestration

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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concept through laboratory tests of drill-core samples and maintain minimum levels of fundamental lab-scale research to addresses process design issues. Continue support for the Arctic Energy Office Activities. *Participants include: NETL, SNL, CMU, U. of Pittsburgh, Princeton, ARC, University of Alaska.*

FY 2003 funding continued development of instrumentation, diagnostics and controls for advanced power systems; model testing and research for Virtual Demonstration plant; development of critical enabling technologies in support of Vision 21; fundamental coal combustion research; and research on fundamental mechanisms for CO<sub>2</sub> mineral sequestration process, and continue support for the Arctic Energy Office activities. *Participants included: Ames Research Lab, SNL, ARC, LANL, NETL, SAIC.*

- **Mercury Control**..... 0 1,961 0

No funding requested in FY 2005.

In FY 2004, conducted fundamental research on mercury formation and control. As part of a new sensors and control solicitation, developed sensors to detect and monitor mercury emissions. Developed atmospheric modeling (plume chemistry and deposition) with a focus towards mercury. *Participants to be determined.*

No funding was requested for this activity in FY 2003.

- **Center for Zero Emissions Coal Research** ..... 0 2,970 0

No funding requested in FY 2005.

In FY 2004, create a strategic center for zero emission coal research at the High-Temperature Electrochemistry Center (HiTEC) to conduct research in support of advanced coal programs and FutureGen, and to enhance collaboration between Universities and national Labs. *Participants include: Montana State Univ., NETL.*

No activity in FY 2003.

- **Program Support**..... 89 119 80

Fund technical and program management support.

**Materials** ..... 8,712 11,111 8,000

- **High Temperature Materials Research**..... 5,365 5,682 3,976

In FY 2005, develop a new generation of corrosion resistant high temperature alloys and refractories that will be used as hot components in advanced fossil energy combustion and conversion systems. Laboratory research is accompanied by testing of the alloys in actual power

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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plant conditions. Demonstrated stability of proton-conducting ceramics in atmosphere of coal-derived gas and operated membrane reactor to produce low cost hydrogen from coal. *Participants include: ANL, INEEL, ORNL, ARC, Ames, Eltron, NETL.*

In FY 2004, continued to develop improved materials for high-temperature, high-pressure heat exchangers, high-temperature inorganic membranes, refractories, and activated carbons for next generation, ultra clean fossil energy power systems. Continued to develop new alloys to include intermetallics, advanced austenitic alloys, advanced ferritic alloys, and oxide-dispersion-strengthened alloys. Functional materials research addressed hot-gas particulate filters, gas separation membranes, and physical absorbents, i.e, advanced carbons and non-destructive evaluation techniques. *Participants included: ANL, INEEL, ORNL, Ames, Eltron, Special Materials, NETL, U. of Cal at SD.*

FY 2003, funding continued development of the high temperature structural and functional materials that are critical enabling technologies needed to achieve the highly efficient, economical and environmentally clean fossil energy power systems for Vision 21. *Participants included: ANL, INEEL, ORNL, Eltron, Ames, ARC, Special Materials, NETL, U. of Cal at SD.*

- **Materials for Ultra Supercritical and Gas Separation Systems .....**

**3,260                      4,503                      3,944**

In FY 2005, identify improved alloys, fabrication processes and coating methods that will permit boiler operation of steam temperatures up to 1400° F and steam pressures up to 5500 psi. Work with alloy developers, fabricators, equipment vendors and power generation plant operators to obtain cost targets for the commercial deployment of alloys and processes developed. Define issues impacting designs that can permit power generation at steam temperatures greater than or equal to 1600° F. Identify materials needed to develop steam turbines capable of operating at the ultra supercritical temperature and pressure conditions and develop a plan to evaluate and qualify materials for the critical components. Increase permeance of new membrane materials for achieving very low cost hydrogen and oxygen separation from mixed gas streams achieving repeatability with defect-free membranes, and employing techniques that can be used in manufacturing on a large scale. Study impact of new materials and processes for stabilizing greenhouse gases for next generation energy plants. *Participants include: LANL, SNL, ORNL, PNNL, Energy Industries of Ohio.*

In FY 2004, developed alloys for ultra supercritical systems with operating temperatures raised to 1400-1600°F; ensure the weldability of these high temperature materials, and developed the base materials technology needed to develop steam turbines capable of operating at the ultra supercritical temperature and pressure conditions which are critical to the success of not only the ultra supercritical program, but also the Vision 21 program. Pursued breakthrough concepts to develop materials for achieving very low cost hydrogen and oxygen separation from mixed gas

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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streams and for stabilizing greenhouse gases for Vision 21 energy plants. *Participants include: LANL, SNL, ORNL, PNNL, ARC, Energy Industries of Ohio.*

FY 2003 funding supported development of alloys for ultra supercritical systems and new materials able to separate hydrogen and oxygen and for stabilizing greenhouse gases at very low costs. These are critical enabling technologies needed to make deployment of Vision 21 energy plants possible. *Participants included: LANL, SNL, ORNL, PNNL, ARC, Energy Industries of Ohio.*

- **Materials for Mercury Control**..... 0 500 0

In FY 2005, no funding is requested for this activity.

In FY 2004, evaluated novel materials for the conversion or removal of mercury from process streams. *Participants to be determined.*

No funding was requested for this activity in FY 2003.

- **Materials for Advanced Fuel Cell Concepts**..... 0 315 0

In FY 2005, no funding is requested for this activity.

In FY 2004, developed advanced concepts that utilize carbon material from coal directly in a fuel cell. Such a concept will permit high and intermediate temperature fuel cells to directly convert carbon to electrical power without the need of an intermediate coal gasification step. National Laboratories may also contribute materials research in support of other advanced fuel cell concepts. *Participants to be determined.*

No funding was requested for this activity in FY 2003.

- **Program Support**..... 87 111 80

Fund technical and program management support.

**Technology Crosscut**..... 11,078 11,326 10,500

**Coal Technology Export**..... 795 988 1,000

- **Coal Technology Export** ..... 795 988 1,000

In FY 2005, intensify the facilitation of the development and deployment of Zero Emissions Technologies for fossil fuels internationally. Continue compounding the pursuit of opportunities identified by the World Energy Council Committee on Cleaner Fossil Fuel Systems and the Southern States Energy Board for the international sale and deployment of U.S. clean coal technologies and advanced power systems. Strengthen established partnerships and pursue the

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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establishment of additional effective partnerships to advance U.S. interest in environmental protection by promoting deployment of cleaner energy systems through training, conferences, site visits and information and technical exchanges on clean power systems, best practices, privatization with targeted utilities and governments, and advising countries on identification and elimination of barriers for deployment of cleaner coal and power systems. Promote the deployment of carbon capture and storage technologies worldwide, and provide support for the Carbon Sequestration Leadership Forum. Initiate the implementation of Clean Energy/Industrial Ecology Projects in developing countries as a means of Mitigating CO<sub>2</sub> emissions growth as these countries expand electrification. *Participants to be determined.*

In FY 2004, sustained continued support for collaboration of zero emission technologies internationally. Intensified the pursuit of opportunities identified by the World Energy Council Committee on Cleaner Fossil Fuel Systems and the Southern States Energy Board for the international sale and deployment of U.S. clean coal technologies and advanced power systems. Continue pursuit of the establishment of effective partnerships to advance U.S. interests in environmental protection by promoting deployment of cleaner energy systems through training, conferences, site visits and information and technical exchanges on clean power systems, best practices, privatization with targeted utilities and governments and advising countries on identification and elimination of barriers for deployment of cleaner coal and power systems. This funding level supported fewer conferences and site visits when compared to FY 2003. *Participants to be determined.*

FY 2003 funding continued development of training, conferences, site visits, and information and technical exchanges in order to promote the deployment of cleaner energy. *Participants included: Latin America, China, Australia, Africa, India.*

<b>Bioprocessing of Coal .....</b>	<b>1,341</b>	<b>1,481</b>	<b>1,500</b>
• <b>Bioprocessing of Coal .....</b>	<b>1,328</b>	<b>1,466</b>	<b>1,485</b>

In FY 2005, continue testing at large scale (power plant) toxin process to safely control zebra mussels as a means of improving the efficiency and reliability of existing power plants. Continue development of technical protocol for screening marine microalgae for maximum biofixation and its conversion into alternative fuels. Complete development of bench scale testing of biohydrogen from carbon containing waste products to determine food sources that will support microbial growth and hydrogen production. Continue to investigate global, and natural CO<sub>2</sub> sequestration. Demonstrate whittings catalyzed CO<sub>2</sub> fixation at pilot scale. Investigate production value of added chemicals via nonaqueous biocatalysis. Continue bioremediation of coal to reduce mercury emissions when burned in power plants. *Participants include: ORNL, INEEL, PNNL, NY State U., NETL.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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In FY 2004, initiated large scale testing to develop toxin to safety control zebra mussels as a means of improving the efficiency and reliability of existing power plants. Initiated development of technical protocol for screening marine microalgae for maximum biofixation and its conversion into alternative fuels. Investigated global, natural CO<sub>2</sub> mitigation strategies such as whittings and ocean scale algae sequestration. Continued development of biogeochemical environmental remediation of ammonia discharges associated with coal wastes from existing power plants. In furtherance of launching the hydrogen economy, investigated biohydrogen generation from carbon containing waste products to determine food sources that will support microbial growth and hydrogen production, conduct tests at bench scale. Investigated novel bio-environmental remediation processes related to coal conversion technology. *Participants include: ORNL, INEEL, U. State of NY, Cal. State U.*

FY 2003 funding continued development of CO<sub>2</sub> mitigation strategies, such as whittings; develop toxin for control of zebra mussels; and biohydrogen generation from carbon containing waste products. *Participants included: ORNL, INEEL, U. of State of NY, Calif. State U.*

• <b>Program Support</b> .....	<b>13</b>	<b>15</b>	<b>15</b>
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Fund technical and program management support.

<b>Environmental Activities</b> .....	<b>1,987</b>	<b>1,975</b>	<b>2,000</b>
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• <b>Environmental Analyses and Studies</b> .....	<b>1,987</b>	<b>1,975</b>	<b>2,000</b>
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In FY 2005, continue analyses of issues associated with air and water quality, solid waste disposal, and toxic substances, and global climate change. Continued emission trends and forecast studies. *Participants include: ANL, ICF, Resource Dynamics, TMS, PNNL*

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FY 2003 funding continued environmental issues analyses of ambient, water, solid effluents, and global climate change and conducted emission trends and forecast studies. *Participants included: ANL, ICF, Resource Dynamics, TMS, PNNL.*

<b>Technical and Economic Analyses</b> .....	<b>994</b>	<b>988</b>	<b>1,000</b>
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• <b>Technical and Economic Analyses</b> .....	<b>994</b>	<b>988</b>	<b>1,000</b>
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In FY 2005, continue studies supporting multi-year planning FE strategy and program formulation; conducted contract fewer studies on issues that crosscut FE programs including strategic benefits of and new markets for fossil fuel technology. Conducted critical studies to



(dollars in thousands)

FY 2003	FY 2004	FY 2005
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identify major challenges, "leapfrog" technologies, and advanced concepts that are applicable to fossil energy systems, and have the potential to improve their efficiency, cost, and/or environmental performance. *Participants include: ANL, ICF, EIA, Resource Dynamics, TMS.*

FY 2004 funding continued studies supporting multi-year planning FE strategy and program formulation; conducted contract fewer studies on issues that crosscut FE programs including strategic benefits of and new markets for fossil fuel technology. Conducted critical studies to identify major challenges, "leapfrog" technologies, and advanced concepts that are applicable to fossil energy systems, and have the potential to improve their efficiency, cost, and/or environmental performance. *Participants include: ANL, ICF, EIA, Resource Dynamics, TMS.*

FY 2003 funding continued studies supporting multi-year planning, FE strategy and program formulation; conducted contract studies on issues that crosscut FE programs including strategic benefits of and new markets for fossil fuel technology. Conducted critical studies to identify major challenges, "leapfrog" technologies, and advanced concepts that are applicable to fossil energy systems, and have the potential to improve their efficiency, cost, and/or environmental performance. *Participants included: ANL, ICF, EIA, Resource Dynamics, TMS.*

<b>International Program Support .....</b>	<b>994</b>	<b>988</b>	<b>1,000</b>
<b>• International Program Support.....</b>	<b>994</b>	<b>988</b>	<b>1,000</b>

In FY 2005, continue Fossil Energy's commitment to the International Energy Agency (IEA) program support. Continue to provide leadership, direction, cooperation and coordination of office activities with other Federal agencies, state and local governments, energy trade associations, and the energy industry. Continue preservation and enhancement of active relationships with national and international organizations such as the World Energy Council (WEC), United States Energy Association (USEA), Southern States Energy Board (SSEB), and universities and other non-governmental organizations. Enhance the expansion of cleaner energy technology power systems activities in southern and western regional African countries, eastern Europe, the Pacific Rim, Russia and Newly Independent States, South Asia/Near East, western Europe, and the Western Hemisphere. Promote the deployment of carbon capture and storage technologies worldwide. Influence opportunities for cleaner power systems and clean fuels from coal in selected countries. Initiate the implementation of Clean Energy/Industrial Ecology Projects in developing countries as a means of mitigating CO<sub>2</sub> emissions growth as these countries expand electrification. *Participants to be determined.*

FY 2004 funding continued support of Fossil Energy's commitment to the International Energy Agency (IEA) program effort. Provide leadership, direction, cooperation and coordination of office activities with other Federal agencies, state and local governments, energy trade associations, and the energy industry. Preserved and enhanced active relationships with national and international organizations such as the World Energy Council (WEC), United States Energy

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Association (USEA), Southern States Energy Board (SSEB) and universities and other non-governmental organizations. Focused on expanding cleaner energy technology power systems activities in Southern and Western regional African countries, Eastern Europe, the Pacific Rim, Russia and Newly Independent States, South Asia/Near East, Western Europe, and the Western Hemisphere. Determined opportunities for cleaner power systems and clean fuels from coal in targeted countries. *Participants to be determined.*

FY 2003 funding continued the maintenance and heightening of established relationships with national and international organizations with emphasis on collaboration, transfer, and deployment of zero emission technologies. *Participants included: WEC, USEA, SSEB, universities and other non-governmental organizations.*

<b>Focus Area for Computational Energy Science .....</b>	<b>4,967</b>	<b>4,905</b>	<b>4,000</b>
<b>• Focus Area for Computational Energy Science.....</b>	<b>4,917</b>	<b>4,856</b>	<b>3,960</b>

In FY 2005, NETL to continue development of virtual simulations capability using mathematical computational simulations and modeling to accelerate development time and reduce costs of technology systems that have high efficiencies with near-zero emissions to reduce the effects of coal use on global warming. Begin to apply the virtual integrated simulators of high efficiency and near-zero emission processes to study proposed systems and evaluate their design and performance. Analyze and evaluate these advanced processes, using the advanced simulation capability, at both the individual component level and overall system level. Complete the initial application of process simulation of high efficiency and near-zero emission process incorporating MFIX-based component model describing an advanced gasification process to provide detailed information describing the gasification process. Complete the initial application of process simulation of high efficiency and near-zero emission process based on fuel cell/gas turbine hybrid system which incorporates a detailed fuel cell component model that will provide detailed information describing fuel cell stack performance. At a reduced level of effort, continue the Supercomputing Science Consortium support activities in advanced simulations by providing high performance computing, internet access, technical support and visualization development in direct support of virtual integrated simulators. Complete a virtual integrated simulation of a high efficiency and near-zero emission process, such as a hybrid or advanced gasifier, to demonstrate the ability to simulate a dynamic coupled system. *Participants include: NETL, CMU, U. of WVU, State of WV, PSCC, U. of Pittsburgh.*

In FY 2004, NETL continued development of virtual demonstration capability using mathematical simulations and modeling to improve the speed and reduce the costs of technology systems that have high efficiencies with near-zero emissions to reduce the effects on global warming. Developed simulations that couple fluid flow, chemical reactions, heat generation, heat transfer, and electrochemistry for modeling multi-dimensional transients in fuel cells, heat engines, gasifiers, and other crucial unit processes in Vision 21 plants. Completed CFD models of fuel

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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cells, turbines, and gasifiers. Enhanced multi-phase flow models (MFIx) with meshing, large eddy simulations and chemistry and heat transfer improvements. Integrated subsystem component modules and dynamic system models to simulate a first case Vision 21 plant. Continued to perform data reduction and data extraction on extensive information available from simulations of advanced energy plants for incorporation into codes being developed. Continue supercomputing Science Consortium supporting activity in advanced simulations by providing high speed computing, technical support, and visualization simulations. *Participants include: Carnegie Mellon University, University of West Virginia, Pittsburgh Supercomputing Center, University of Pittsburgh.*

FY 2003, funding continued development of models and dynamic simulations of advanced energy plants, including modeling tools for sub-elements in turbines and fuel cells. Integration of subsystem component modules and dynamic system models into virtual models. Supercomputing Science Consortium support in advanced simulations utilizing high performance computing and communications. *Participants included: NETL, CMU, U. of WV, State of WV, PSCC, U. of Pittsburgh.*

• <b>Program Support</b> .....	50	49	40
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Fund technical and program management support.

<b>University Coal Research</b> .....	<b>2,904</b>	<b>2,945</b>	<b>3,000</b>
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• <b>University Coal Research</b> .....	<b>2,875</b>	<b>2,916</b>	<b>2,970</b>
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In FY 2005, the University Coal Research (UCR) Program plans to continue to support grants at U.S. colleges and universities by emphasizing longer-term research for achieving Fossil Energy's strategic objectives. Critical key research areas that accelerate technology development and seeking to identify breakthrough technologies for the next century will be supported. The key research areas that will be supported will include: Vision 21, hydrogen initiative, global climate change, coal-based mercury emissions, materials, sensors and controls, and coal-by-product utilization for the measurement, characterization, and the development of cost-effective control technologies.

Support will continue in all three portions of the UCR Program: the Core, Innovative Concepts Phase-I and, Innovative Concepts Phase-II areas. Under the Core area, the program will continue to encourage collaboration through joint proposals involving university/industry teams. \$200,000 to \$400,000 grants will be awarded in this area. The number of grants will depend on the number of meritorious proposals submitted.

Exploration of novel approaches and innovative concepts developed in other scientific and technological areas that assist in developing breakthrough technologies for coal utilization will

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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also be continued in the Innovative Concepts Phase-I and Phase-II areas. Approximately six to eight, \$50,000, one year, Innovative Concepts Phase I grants could be awarded. Further, plans are to continue the Innovative Concepts Phase II Program where one or more Phase I projects can be selected for a \$200,000 Phase-II grant award. *Participants to be determined.*

FY 2004, funding supported grants at U.S. universities which emphasized longer-term research that will accelerate technology development and identify breakthrough technologies for the next century; focus was on scientific and technological issues that are key to achieving FE's strategic objectives. The support continued in critical key research areas to include Vision 21, global climate change, materials, sensors and controls, and by-products from coal. Breakthrough technologies for the measurement, characterization, and the development of cost-effective control technologies for fossil coal-based mercury emissions was also sought. *Participants to be determined.*

Exploration of novel approaches and innovative concepts developed in other scientific and technological areas that assist in developing breakthrough technologies for coal utilization was continued. Approximately six to eight, \$50,000, one year, Innovative Concepts Phase-I Projects could be awarded. Further, plans are to continue the Innovative Concepts Phase II program.

FY 2003, funding provided competitively awarded research grants to U.S. colleges and universities to address FE's highest priority research needs, supported joint proposals involving university and industry teams of researchers, and continued to explore novel approaches and Innovative solutions to achieve technological breakthroughs for clean coal utilization and support to Vision 21. *Participants included: Various colleges and universities.*

• <b>Program Support</b> .....	<b>29</b>	<b>29</b>	<b>30</b>
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Fund technical and program management support.

<b>HBCUs, Education and Training</b> .....	<b>969</b>	<b>981</b>	<b>1,000</b>
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• <b>HBCUs, Education and Training</b> .....	<b>959</b>	<b>971</b>	<b>990</b>
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Conduct research activities with HBCU and other minority institutions and support an HBCU annual technology transfer symposium. *Participants to be determined.*

FY 2004 and FY 2003 funding continued research activities at HBCU and other minority institutions and supported HBCU annual technology transfer symposium. *Participants included: Various colleges and universities.*

• <b>Program Support</b> .....	<b>10</b>	<b>10</b>	<b>10</b>
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Fund technical and program management support.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
<b>Total, Advanced Research</b> .....	<b>32,444</b>	<b>38,215</b>	<b>30,500</b>

### Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)
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#### Coal Utilization

- Eliminate funding for mercury control. No funding is requested for the Center for Zero Missions Coal Research which was established in FY 2004. Since there will be a delay in fully implementing this program in FY 2004, current funding will continue the program through FY 2005. Increased funding for sensors and control and enabling technologies activities..... -3,852

#### Materials

- Decrease funding for high temperature materials research and materials for ultra supercritical and gas separation activities. Eliminate funding for mercury control and materials for advanced fuel cell concepts..... -3,111

#### Technology Crosscut

- Activities continued at a reduced level of effort ..... -826

#### University Coal Research

- Award one additional innovative concept Phase-1 grant ..... +55

#### HBCUs, Education and Training

- Activities continue at current level of effort ..... +19

<b>Total Funding Change, Advanced Research</b> .....	<b>-7,715</b>
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